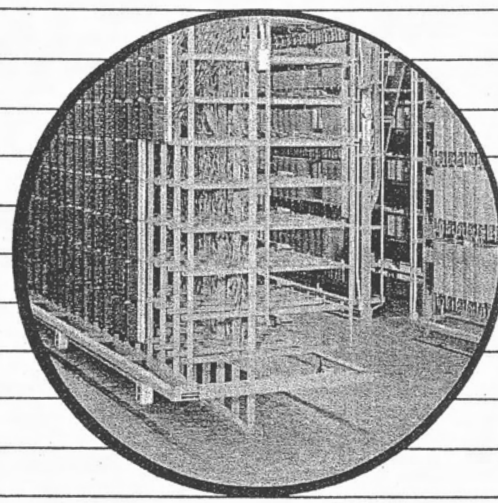
Distributing Fra[illegible]s 803

AUTOMATIC ELECTRIC TRAINING SERIES | Bulletin **803**

DISTRIBUTING FRAMES

STROWGER AUTOMATIC TELEPHONE SYSTEMS



AUTOMATIC ELECTRIC ®

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AUTOMATIC ELECTRIC TRAINING SERIES
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STROWGER AUTOMATIC TELEPHONE SYSTEMS

800 Electrical Principles of Telephony
801 Mechanical Principles of Telephony
802 Fundamentals of Apparatus and Trunking
803 Distributing Frames
805 The Plunger Lineswitch and Associated Master-Switch
806 Rotary Lineswitch
807 The Connector
808 The Selector
810 Pulse Repeaters
812 Power and Supervisory Equipment
813 Party-Line Connectors and Trunk-Hunting Connectors
814 Reverting-Call Methods
815 The Test and Verification Switch Train
816 Toll Switch Train
817 Switching Selector-Repeater
818 Private Automatic Exchanges with PABX Appendix
820 Manual Switchboards
821 Linefinder Switches

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CONTENTS

DISTRIBUTING FRAMES

1. GENERAL

1.1 Introduction. Strowger apparatus is mounted as shelves of equipment. These equipped shelves are hung on framework known as bays or trunkboards. Except in the smaller office, types of switches are not mixed within the same trunkboard. However, bays of dial switching equipment is not a working exchange. These shelves of equipment must be connected properly to each other. Since these connections total many thousands for even a medium sized office; some orderly, simple, and flexible method for making them had to be devised.

This requirement was met, in part, through the use of insulated cables of various circuit capacities and terminal blocks capable of accommodating them in a limited space. These blocks, when mounted on equipment shelves, provide a junction point between associated circuits mounted in different locations.

However, it is usually impractical to cable and wire equipment by a direct shelf to shelf method. This arrangement provides no flexibility and connections, once made, can be changed only with great difficulty. Since telephone exchanges grow year after year and traffic through them varies from time to time; established connections must be readily changeable if efficient central office equipment use and operation is to be maintained. This flexibility is provided through the use of one or more distributing frames.

Cables are now essentially shelf to distributing frame runs. Jumpers interconnect them as required. Since jumpers are easily changed, they may be considered as temporary connections that can be quickly moved to meet changes in office traffic and trunking plans.

1.2 Distributing frames. There are five types. The following preview briefly covers their functions.

The main distributing frame, MDF, provides the cabling space and terminations for the outside plant and certain switching equipment such as telephone lines and outgoing trunk circuitry. It also mounts equipment protective devices and acts as a test point between the outside and inside plant.

The line intermediate distributing frame, LIDF, provides for the termination of line relay circuits and connector bank contacts as well as bunching block facilities for party line service and EC ring control in T/S exchanges. The MDF tie cable is wired to the vertical side.

The trunk intermediate distributing frame, TIDF, provides cabling space and cross-connecting facilities between the dial switching equipment and all other associated apparatus such as toll boards, test desks, trunk equipment, linefinders-first selectors, etc. To reduce cable lengths, a single-sided TIDF is often employed in a trunkboard lineup.

The combined distributing frame, CDF, combines the functions of the MDF, the LIDF, and the TIDF. This unit is erected as one continuous framework and like the MDF is placed over the cable vault. Large exchanges often require a separate LIDF and in these cases only the TIDF verticals are added to the MDF sections of the CDF.

The distributing terminal assembly, D.T.A., is physically different but functionally the same as the other frames. Cables are wired permanently to blocks and the jumpering is extensive. This single-sided frame mounts selector bank terminal strips and two rows of vertical blocks for outgoing trunk cables. It provides a flexible method for connecting selector bank contacts to each other or to outgoing trunks as required for a selector bank contact multipling or "grading" scheme.

Except for the D.T.A., the frames are not fixed as to size or arrangement. They vary as the office they serve varies in size and requirements. Their design fits into any floor plan and permits additions needed for future growth. Other materials and equipment are needed to supplement them in performing the distributing functions.

1.3 Auxiliary distributing equipment. There are four supplementary items; the MDF protector, the terminal block, switchboard cable, and jumper wire. They are "as required items" being used in varying quantities depending upon the size and requirements of the central office.

1.3.1 MDF protectors. A pair of protectors is illustrated in figure 1. Pairs, when assembled in groups on mounting plates, form protector strips which are designed to mount on verticals of the MDF. The mounting plate divides the protector into two parts; the right or jumper side and the left or cable side. Solder lugs

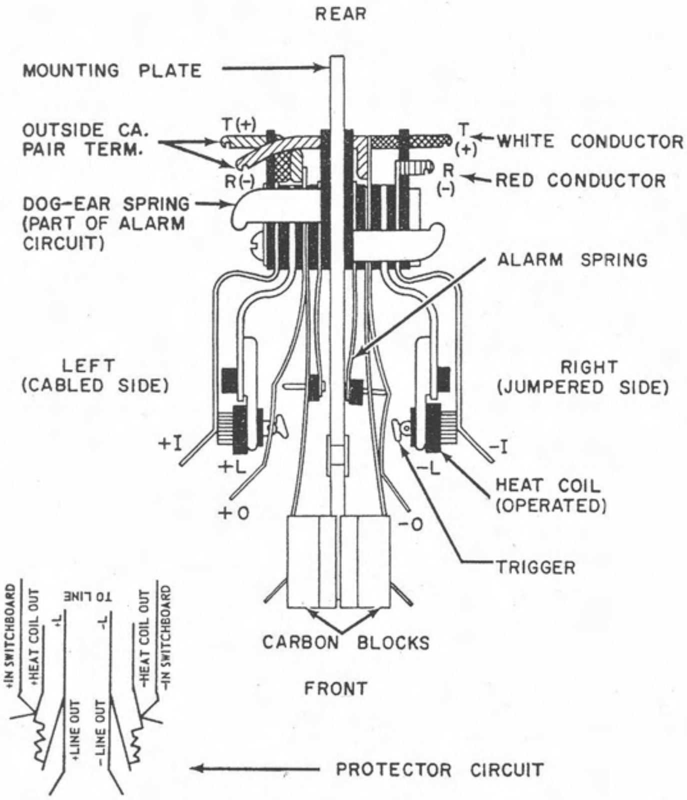


Figure 1. MDF protector and circuit equivalent.

provide terminating facilities for the outside plant on one side and inside equipment on the other.

1.3.2 Terminal blocks. A terminal block cross-section is illustrated in figure 2. The wood fanning strip is drilled with a series of holes on both sides and opposite the solder lugs. Wires or jumpers pass through these holes before being connected to the lugs. Pertinent information on the terminal blocks is listed below:

1. Lugs are double notched.

2. Block sizes are expressed as the number of rows, in this case 6, by the number of terminals per row; i.e., 6 x 25; 6 x 20; etc.

3. Blocks mount horizontally or vertically.

4. Vertically mounted blocks have cable wires connected to the left and jumpers to the right side. Horizontally mounted blocks have cable wires connected below and the jumpers above or upper side.

5. Block sizes are selected according to the number and size of the circuits wired thereon.

6. Strapping, when required, is placed on the inside notch of the terminal lugs.

7. Circuits are numbered from left to right or from top to bottom. Stenciling identifies circuits and individual circuit leads.

8. Row 1 is closest to the fanning strip. References made "as seen from front of block".

9. Blocks are mounted either with screws and nuts using the fanning strip mounting holes or with screws through tapped holes in the base mounting strip.

1.3.3 Switchboard cable. Switchboard cable is made up of individual plastic covered, insulated wires bunched under a single plastic cover. Wires may be paired, single, or a combination of both. Cables are designated according to the number of conductors under this single sheath. They are cut to length, usually on the job, and run between specified terminal blocks as a permanent part of the office. A group of cables serving the same equipment is called a run and is numerically designated for identification.

Cables of different capacites are available to the engineer so that he may choose the ideal size for the equipment it is to serve. Except for linefinder and connector bank cables, sizes that permit its complete wiring to one block, one shelf, etc., is desirable. Hence this supply of cable sizes from 8 to 402 conductors.

1.3.4 Jumper wire. Single, paired, three, or four conductor plastic insulated flexible wire runs are called jumpers. Their function is to cross-connect associated circuits of block terminated or block and protector terminated cable runs. Jumpers can be easily changed without disturbing the permanent wiring. This is basic telephone operating practice and much jumpering is in evidence in central offices.

Each conductor, of a jumper run, is colored differently for identification purposes. Jumper wire is supplied in coils from 1000 to 5000

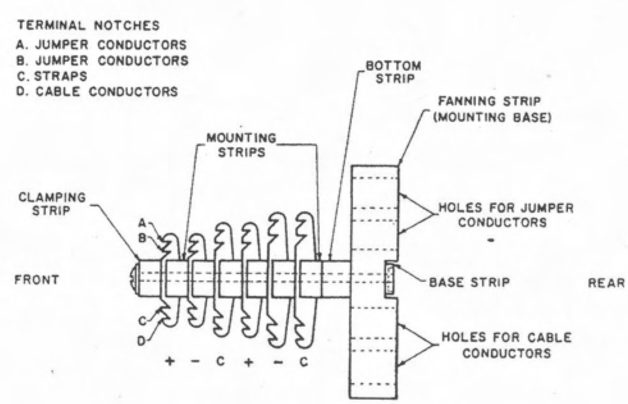


Figure 2. Terminal block - cross section.

feet. It is run through frame jumper rings and block fanning strip holes, then cut to a length that permits its wiring to the proper lugs with sufficient slack for tracing purposes.

Jumpers are connected to the top of horizontally mounted and on the right of vertically mounted blocks. The other sides, of course, accommodate the cable conductors.

These then are the materials supplied to the installer for making quantities of switching equipment into a working telephone office. Signal cables and power leads are also needed to extend these services to the equipment shelves but are not a part of this bulletin.

1.4 Types of central office cabling. Exchange cables, excluding power and signal runs, are divided into two groups; (1) those used to connect subscriber's dial office equipment together and to his telephone line, and (2) those needed to complete the balance of the equipment interconnections.

The first group or the line cables terminate on a LIDF and tie to the MDF, or terminate on the CDF, or terminate directly on the MDF.

The second group or the trunk cables terminate on a TIDF and tie to the MDF, or terminate on a CDF, or directly on the MDF. Trunk cables also terminate on the D.T.A. The functions, terminations, and general arrangements of these cables apply to all office types and are to this extent alike whether the exchange be T/L, T/S 3-wire, or T/S 4-wire.

This, however, is not the case with line cables and cabling. Their functions are the same but their terminations and general arrangements vary according to the size and type of office. A study of office types will help explain this statement. A better appreciation for the need of one or more distributing frames demands an understanding of central office types and their requirements.

1.5 Central office types. The methods and arrangement's for providing subscriber's lines with their central office equipment and especially as this applies to the formation of party lines and party line station signaling determines the central office type. These methods and arrangements, in turn, plus the size of the exchange determine the distributing frame requirements.

A telephone station requires three central office components: (1) a line relay circuit to permit access of dialing equipment for originating calls; (2) a set of connector bank contacts, which determines its directory number, to permit its being called; and (3) a pair of MDF protectors for junctioning this inside equipment to an outside cable pair leading to the instrument.

If all stations used individual line service, line cable termination would be a straightforward procedure. The number of stations, protector pairs, line relay circuits, and connector bank contacts could be equal. However, much telephone service is based on the use of party lines and this fact alone opens up many possibilities as to the most efficient and economical methods for providing it. Many factors, which differ in extent and application for each office area, determine central office efficiency and economy. Suffice to say that the office types, described below, reflect the alternatives available to meet this problem.

Station signaling for a dial office using Strowger switching equipment will be arranged along the lines of one of the plans illustrated in figure 3. Two plans may be combined within a single exchange, when required; but this is not usual. The fundamental differences between the three plans are obvious.

The cabling and frame requirements for each station signaling system is illustrated in figures 4, 5, and 6. Again the fundamental differences are obvious.

A telephone line in the terminal-per-line (T/L) exchange, whether single or multi-party, requires but one connector bank assignment and of course one line relay circuit, see figure 3A. Party line directory numbers, except for the last digit, are the same. All ringing codes are wired to the connector shelves and thus the switches via individual leads. The signaling code of the called party is selected by a minor switch in the connector. Therefore, a 3-digit connector is supplied. Sets of connector bank contacts and line relay circuits are supplied in equal amounts. Typical cabling plans for the T/L office is shown in figure 4.

A telephone station in a terminal per station (T/S) exchange using the 3-wire or frequency per shelf ringing plan requires a connector bank assignment and of course a line relay circuit, see figure 3B. Again the connector bank assignment determines the directory number but in this case it is just a single party number. Should party line service be desired with this particular line relay circuit, additional connector bank assignments must be added, each a different directory number.

To facilitate the formation of such a party line, where several jumpers are needed, the use of bunching blocks has been instituted. A single ringing code is wired to the connector shelf and thus the switches via a single lead.

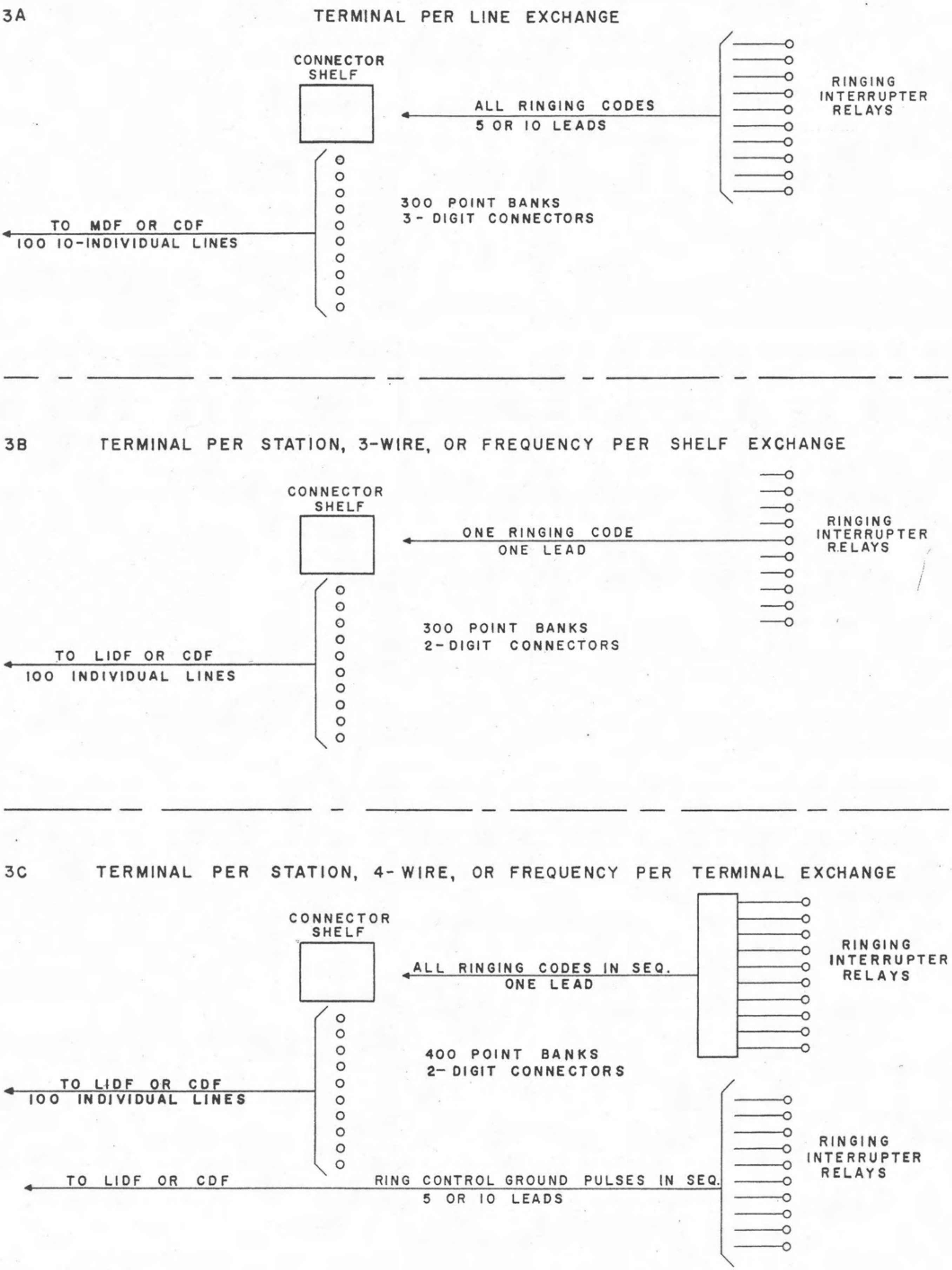


Figure 3. Station signaling systems.

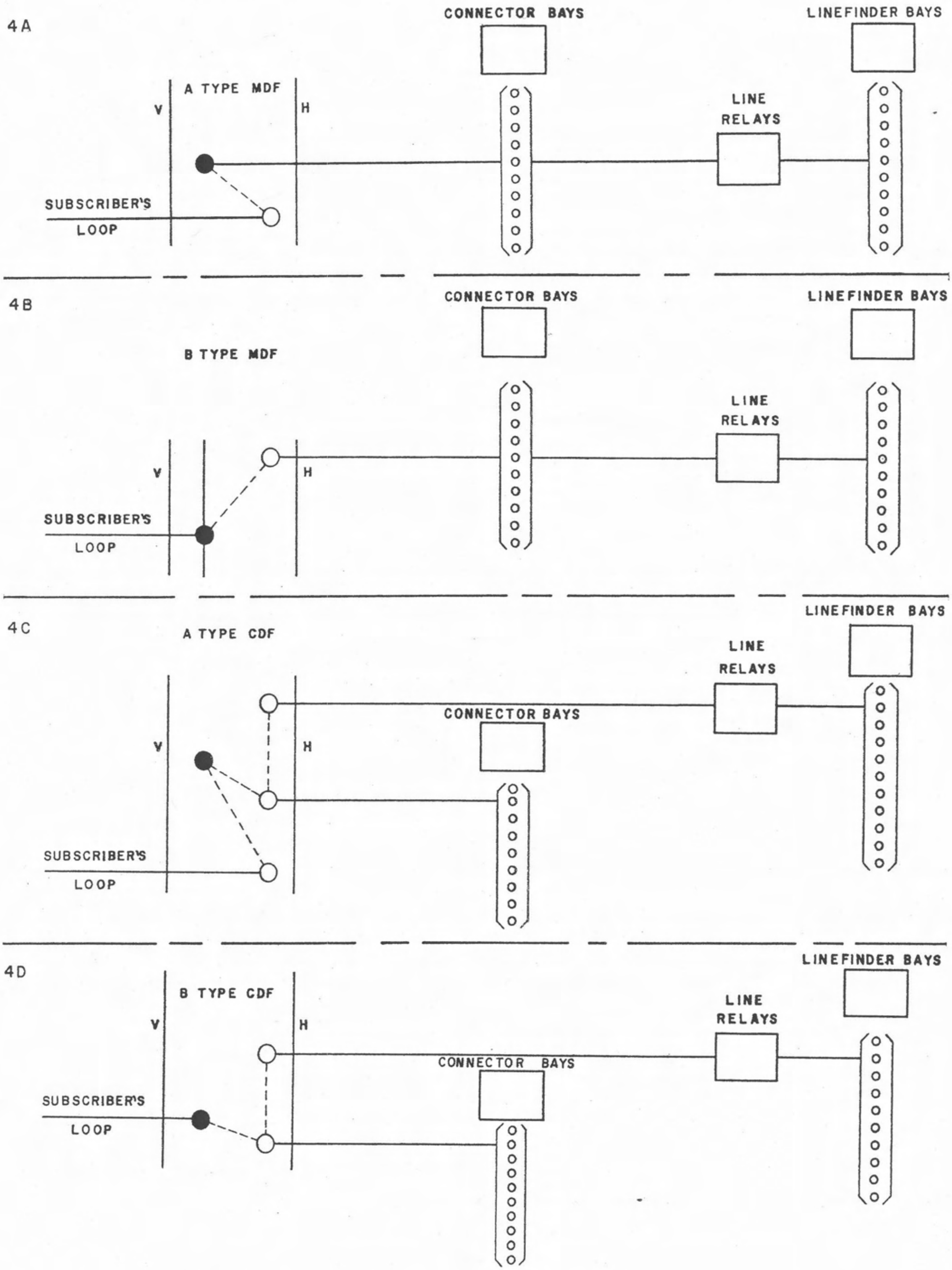


Figure 4. Terminal per line office. (Line cabling and frame jumpering.)

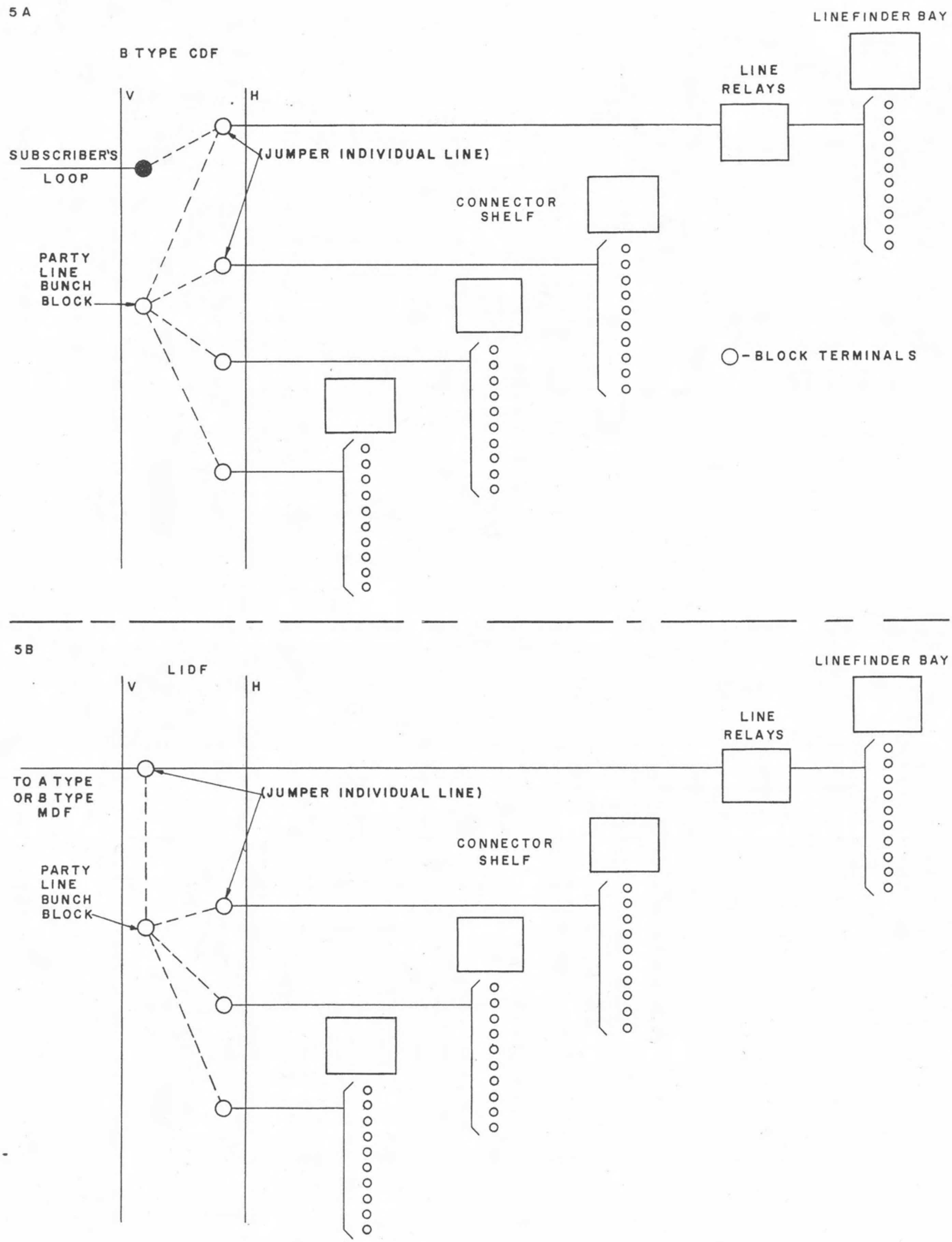


Figure 5. Terminal per station 3-wire or frequency per shelf office.
(Line cabling and frame jumpering.)

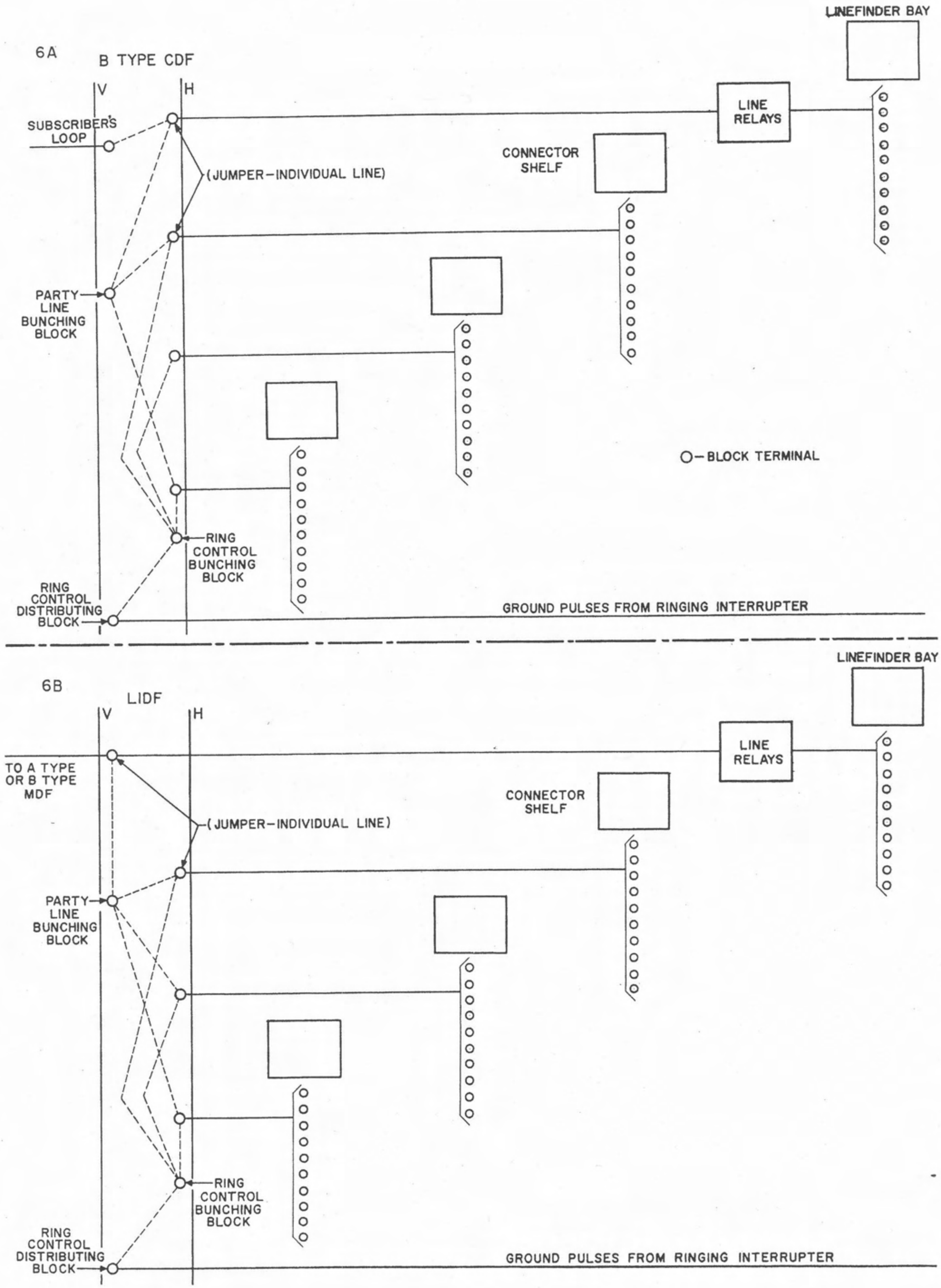


Figure 6. Terminal per station 4-wire or frequency per terminal office. (Line cabling and frame jumpering.)

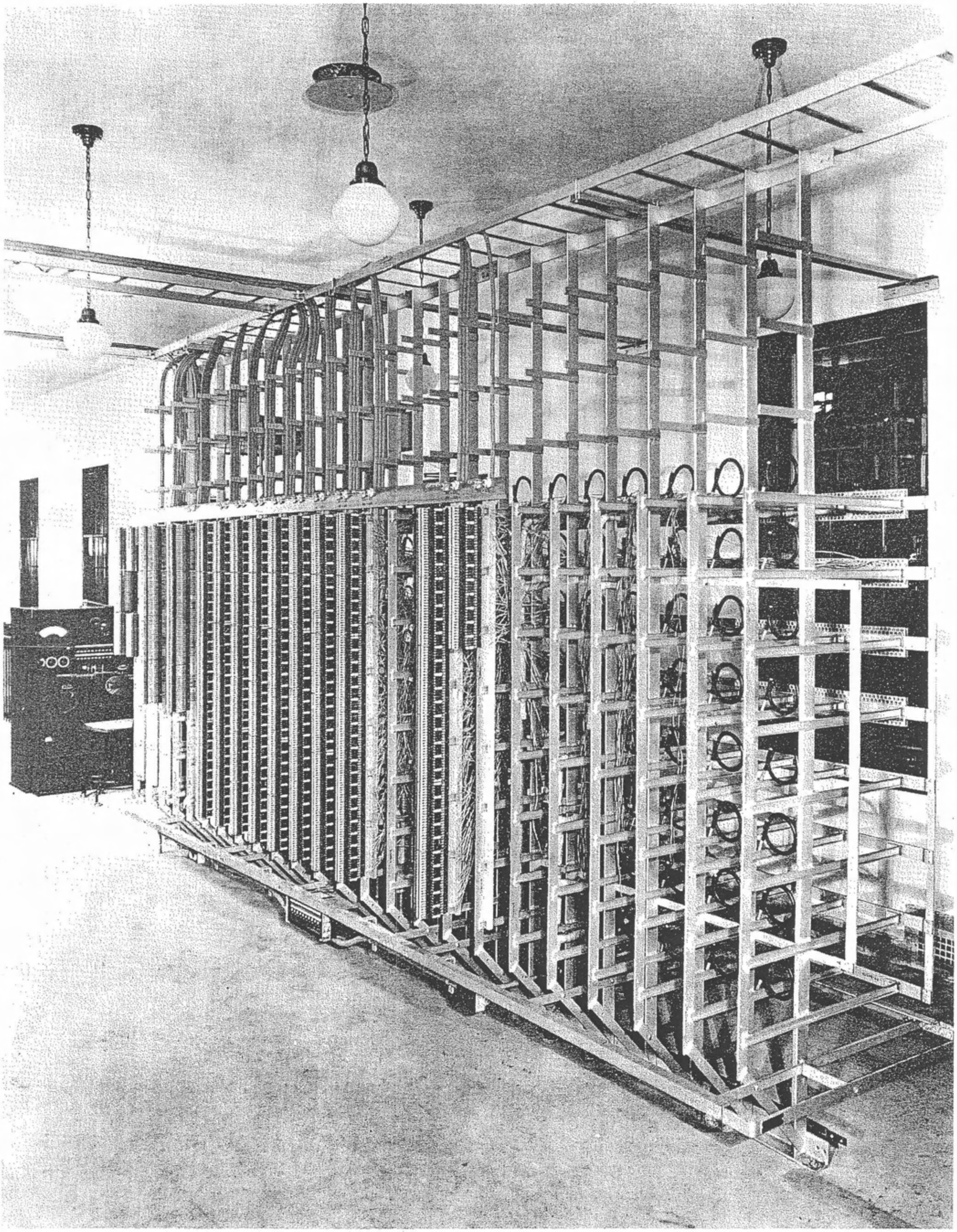


Figure 7. Main distributing frame.

The called party is automatically signaled and only a 2-digit connector is needed. Typical cabling plans for this type of T/S office is shown in figure 5. Sets of connector bank contacts exceed line relay circuits at a ratio based on the expected ratio of party line stations to total subscriber stations for the exchange.

The terminal per station (T/S) 4-wire or frequency per terminal office differs in one respect from the 3-wire or frequency per shelf office, see figure 3C. Basically this difference is one of flexibility in the assignment of station ringing codes. In a 3-wire office the ringers of all stations assigned to a particular connector shelf must be the same. This direct relationship between directory numbers and ringing codes mean that one cannot be changed without changing the other. In a 4-wire office the ringers of all stations assigned to a particular connector shelf need not be the same. No fixed relationship exists between directory number and the station ringer. One can be changed without changing the other. Thus, station ringing codes in a 4-wire office are assigned on the connector terminal instead of the connector shelf basis.

With this arrangement all ringing codes are delivered to the connector shelf and thus the switches via a single lead. Ringing codes are placed on this ringing lead in sequence so that two are not present at the same time.

Ground pulses, one for each ringing code, are supplied via separate leads to a ring control distributing block on the VLIDF. They are then jumpered to rows of strapped terminals of ring control bunching blocks on the HLIDF. These blocks are assigned by ringing groups for use in conjunction with specific connector bank terminal blocks.

The connector banks are 400 point with the 4th or EC wire used as the ring control lead. Ringing codes and ground pulses are supplied by the interrupters to connector shelf ringing leads and bunching block terminals respectively so that a specific ring control lead is grounded when a specific code is present at the connector shelf. Thus the jumpering of a specific ring control lead to the EC terminal of a connector bank circuit causes the connector to supply a specific ringing code to the called party's ringers. Typical cabling plans for this type of T/S office is shown in figure 6.

Various operating considerations argue for and against each office type. Their validity is not the subject of bulletin 803.

The completion of the introductory remarks permits us to now proceed with the detailed discussion of distributing frames and their application in dial telephone offices.

2. MAIN DISTRIBUTING FRAME

2.1 Design. The MDF, see figure 7, is assembled on location and bolted to the floor, usually over the cable vault, according to an engineered floor plan. The assembled framework is supported to a wall with channel braces. Cable runway, placed above and to the front and rear of the assembly, is fastened to these braces. The lower mounted equipment is protected by a guard rail. Rolling ladders provide easy access to the upper portions of the frame.

A distributing frame is essentially a series of vertical frames fastened together to provide block mounting space for cable terminations and also protector mounting space in the case of the MDF. The individual frames or verticals mount on 8'' centers. They support block mounting strips for the horizontal side of the frame and mount protectors and fanning strips on their vertical side. The verticals are drilled to accommodate the particular protector strip supplied with the MDF. Jumper rings, assembled at the junction point of the horizontals with each vertical, promote orderly jumpering. A copper bar, fastened to each vertical just above the floor angle, is connected to a low resistance ground. Thus, through channel brace and runway connections all equipment frames are grounded for protection of equipment and personnel. Miscellaneous material needed to properly assemble the MDF is supplied as part of the equipment stocklists.

An end view of an equipped MDF vertical is shown in figure 8. Note the protector alarm lamp, the position of exchange cables, switchboard cables, and the jumpers between them; as well as the copper ground bar with its connection to the C.O. ground.

Exchange cables in the example are wired to protection and the switchboard cables to blocks on the HMDF. This is a B type frame. Cabling and wiring is reversed when the A type MDF is used. The protectors must be turned over for A type frame mounting. This is necessary so that the outside line and not the inside equipment will be grounded after the heat coil operates.

Outside cable pairs exceed equipment terminations so from a cost point of view the A type MDF is more economical. However, the B type, when associated with a LIDF to form a CDF, is the better arrangement. Since the B type gives full cable pair protection it is increasing in popularity.

The Automatic Electric Company manufactures protectors in 10 and 20 pair strips on 1/2" centers and 13 and 25 pair strips on 3/8" centers. The former are used with the A type frame and the latter with the B type frame. The additional pair per hundred is supplied

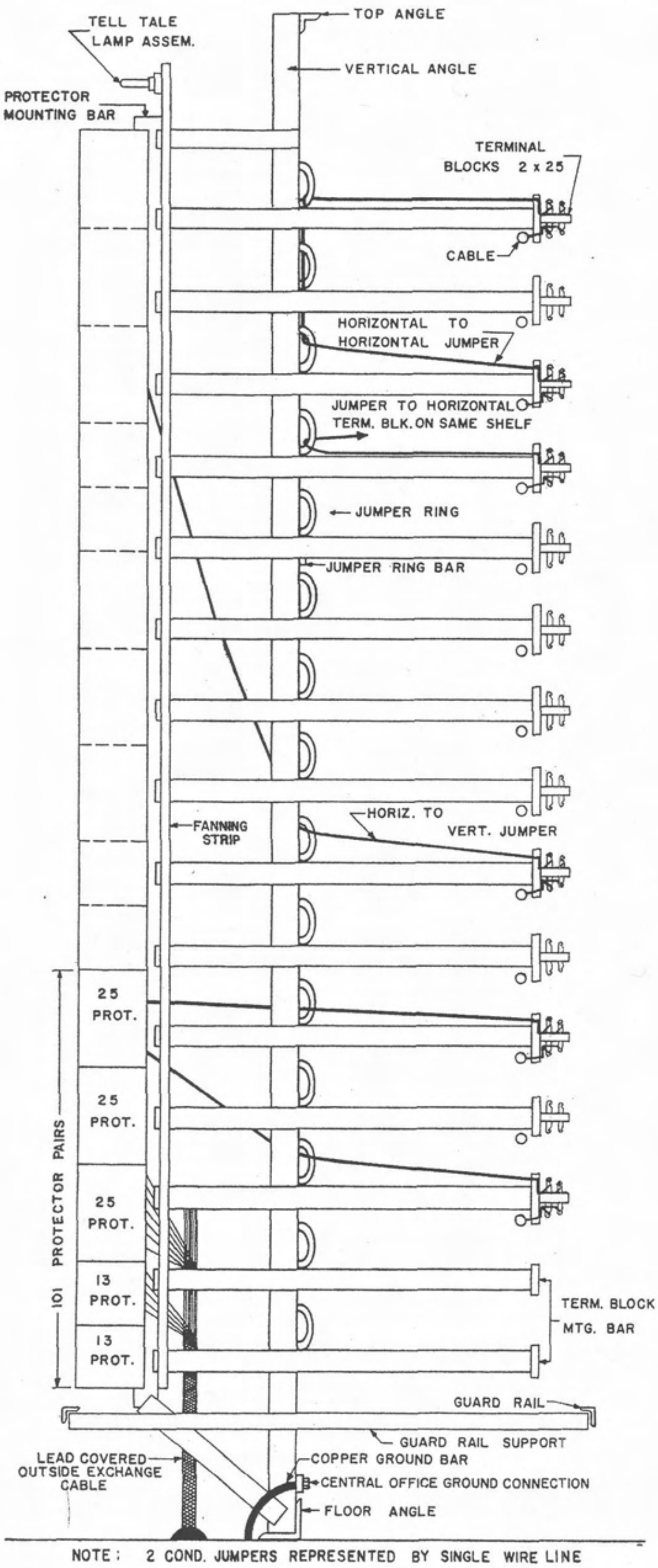


Figure 8. MDF vertical - end view.

for the B type frame because the spare circuits of outside cables, unlike switchboard cables, must be terminated.

2.2 Functions. The MDF is (1) the junction point between inside switching equipment and the outside cable plant, (2) a test point for checking the outside plant, and (3) provides protection for inside equipment and maintenance personnel. The protector, see figure 1, is the means by and through which this is accomplished.

Exchange cables, which have paper insulated conductors, are brought into the central office cable vault. A textile insulated lead sheathed cable is run from this point to the MDF. Splicing the two in the cable vault and wiring the latter to MDF terminations brings subscriber's lines and inter-office trunk circuits to this junction point in the equipment area. Switchboard cables containing the circuits from equipment for subscriber's lines and inter-office trunks are also cabled to and terminated on the MDF. Jumpering exchange cable circuits to switchboard cable circuits through protection completes the number one function of the MDF.

Since the protector is the junction point it is also the separation point between the two segments of the telephone system. This fact explains why through protector design this has become a test point for checking outside plant; the number two function of the MDF. Testing circuits and equipment terminate on a mechanical device, the MDF test shoe. It slips easily between protector springs, separating line and equipment to permit the establishment of testing circuits for checking circuit conditions.

This junction point within the protector is through its heat coil; one for each side of the line, see figure 1. Heat coil operation causes the line to be opened at the protector springs. This action separates equipment from line grounding the latter. A protector alarm circuit alerts maintenance personnel of this fact.

Heat coils operate from two outside causes: (1) high voltage discharges onto the line and (2) low voltage potentials building up on the line. Equipment and personnel are thus protected, the number three function of the MDF.

2.3 MDF terminations. Strickly speaking, besides the outside cable pairs, only line cable circuits are terminated on the MDF. In a T/L office these represent 10-party lines and are identified by their directory number. In a T/S office these represent telephone lines of one or more parties and are identified by their line relay circuit assignment. Hence, the MDF, whether an A type or a B type, serves the same purpose for both office types although their application is somewhat different.

T/L exchanges require no LIDF. The small T/L office will be cabled as per figures 4A and 4B. Larger T/L offices might be cabled as per figure 4D or possibly figure 4C. This plan converts the MDF into what is essentially a CDF which is discussed in §5. The T/S plan has replaced the T/L plan for the large dial exchanges.

Therefore, only the small T/L office will be considered at this time, see figures 4A and 4B. Telephone lines are formed through the use of linefinder to connector shelf tie cables.

Each cable, usually 302 conductor, accommodates 100 3-wire circuits. Subscriber's dial office equipment is directly connected, shelf terminal block to shelf terminal block, resulting in 100 10-party lines per cable. Connector bank contacts and line relay circuits are furnished in equal amounts. Only a 2-wire (+L and -L) circuit is cabled to the MDF and one 202 conductor cable is used for each 100 lines or each connector shelf. Jumpering a 2-wire circuit to a cable pair through protection forms a working telephone line. As this type office grows traffic distribution becomes a problem, complete line fills is impossible, and intercepting and information services thus becomes excessive except in very stable areas.

Figures 5 and 6 illustrate the line cable and frame arrangements for terminal per station exchanges. Small or medium sized offices are generally planned around an arrangement similar to the two shown in figures 5A or 6A. However, these are CDF arrangements and will be discussed in §5. Large T/S offices, where the quantities of line cables are of such size that good operating practice dictates the use of a separate frame for terminating them, use the plans shown in figures 5B and 6B. The MDF cabling and terminations, in these cases, will approximate one of the two plans shown in figures 4A and 4B. However, the switchboard cables, essentially frame to frame tie cables, represent groups of telephone lines of one or more parties. Since these circuits actually represent line relay circuits (+L and -L leads only) they will not be designated by directory number as in the T/L office.

Refer to §3, the LIDF, regarding the formation of party lines in a T/S exchange. In this case the MDF has been supplemented by a second frame, although this in no way changes or eliminates its basic purpose. Telephone lines formed through the use of an LIDF gives to the office that flexibility so necessary in present day operating methods and procedures.

As this type office grows any traffic distribution problems can be easily corrected, complete line fills are possible, and certain auxiliary services will be minimum.

2.4 Summary. The telephone office requires a MDF. Its purposes and functions are identical for all office types. These functions and purposes are:

1. To serve as a junction point between the outside plant and the inside switching apparatus.

2. To serve as a test point for checking outside cable pairs.

3. To provide protection from outside power sources to equipment and personnel.

Two types of frames are available. These are:

1. The A type MDF. Switchboard cables representing switching equipment are directly wired to the protectors. Exchange cables are block terminated on the HMDF.

2. The B type MDF. Exchange cables representing outside cable pairs and subscriber's stations are wired directly to the protectors. Switchboard cables are block terminated on the HMDF.

Any discussion of this frame should involve no other considerations. If it does, the CDF and not the MDF is the subject.

3. LINE INTERMEDIATE DISTRIBUTING FRAME

3.1 Design. The LIDF, which is assembled, erected, and supported in the same manner as the MDF, is made up of individual verticals either 9' 0'' or 11' 8'' high. It is also equipped with a guard rail, jumper rings, and rolling ladders when needed. Cable runway, of course, is arranged along the front and rear of the unit, see figure 9.

Terminal blocks, having individual fanning strips, are mounted on both the vertical and horizontal sides of this frame. These blocks are supplied in a variety of sizes to accommodate the circuitry assigned for termination thereon.

LIDF verticals are designated 1, 2, 3, 4, etc., towards the growing end of the frame while horizontal rows are designated A, B, C, D, etc., from bottom to top. When a TIDF is combined with the LIDF, the TIDF section

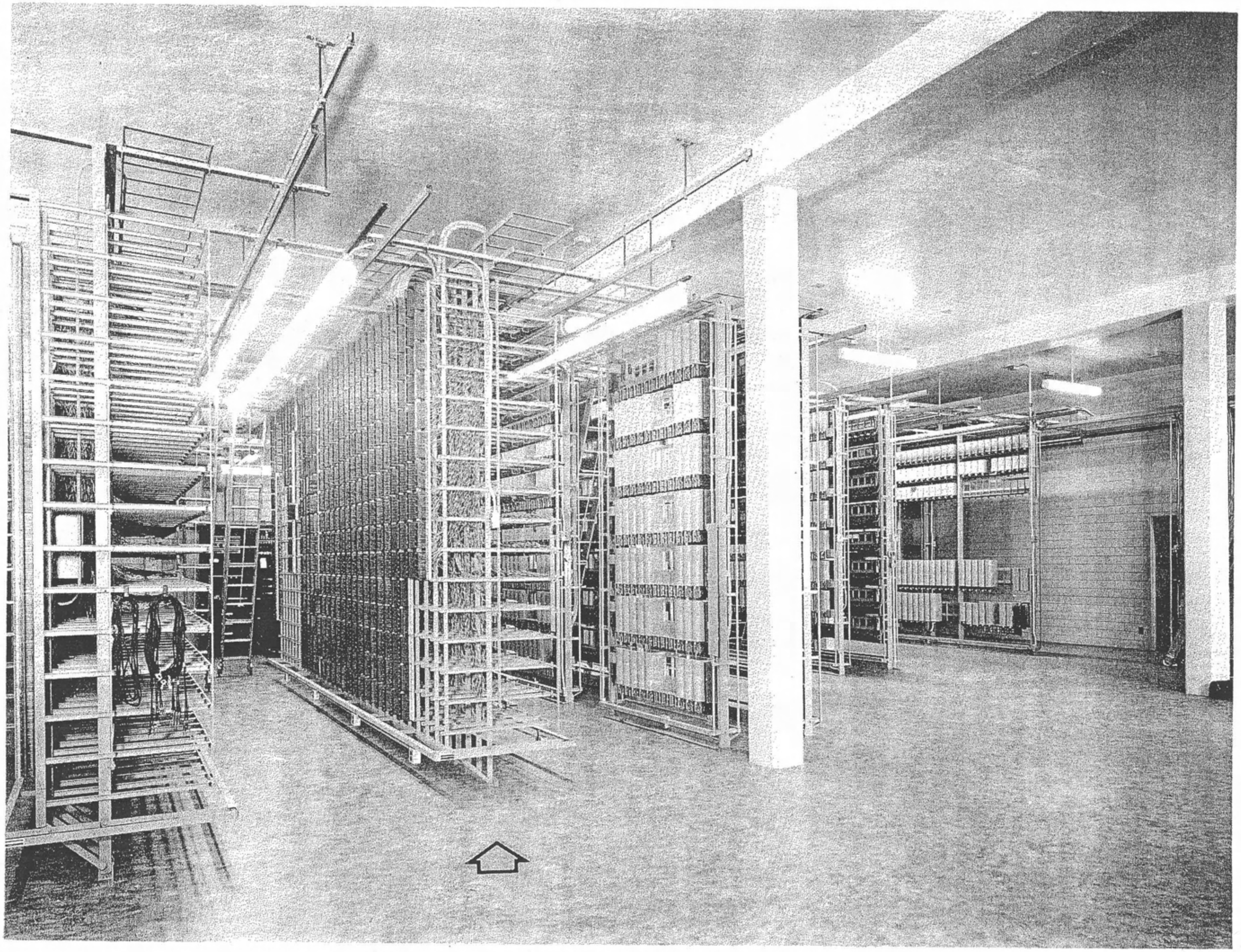


Figure 9. Line intermediate distributing frame.

is designated 01, 02, 03, etc., towards its growing end. Thus verticals 1 and 01 are adjacent on the frame.

The LIDF is usually placed near the MDF to reduce tie cable lengths. Cables are run from the runway directly to vertically mounted blocks and via the horizontal supports to horizontally mounted blocks. This procedure keeps the jumper rings clear for the jumper runs.

Cables are connected to the left side of vertically mounted and the under side of horizontally mounted blocks. Adequate stenciling identifies circuits within a group and leads within a circuit.

3.2 Functions. LIDF facilities are required for only the T/S exchanges. When these facilities are arranged on a separate frame it is cabled according to the plans of figures 5B or 6B; with minor variations, when required, to meet special local operating practices.

The LIDF provides: (1) frame termination for line relay circuits and connector bank contacts; (2) mounting space for party line bunching blocks, intercepting bunching blocks, and, in the case of the 4-wire office, ring control distribution and bunching blocks; and (3) the frame terminations for the tie cables to the MDF. Review §1.5.

Line relay circuits are wired to the VLIDF and connector bank contacts to the HLIDF. Since connector bank contacts exceed line relay circuits there is sufficient mounting space remaining on the VLIDF for the intercepting and the party line bunching blocks. This arrangement plus the use of large sized horizontal blocks, causes both sides of the frame to grow at approximately the same rate. In the 4-wire office ring control distributing blocks are vertically mounted and ring control bunching blocks horizontally mounted between adjacent 100 line groups of connector bank terminals.

Line cables from the linefinder shelves and tie cables to the MDF wire to (3 x 20) or in certain instances (6 x 20) terminal blocks on the basis of 5 blocks per cable. Line cables from the connector shelves wire to (6 x 25) or (8 x 25) terminal blocks on the basis of 4 blocks per cable.

Party line bunching blocks are manufactured in a variety of sizes and strapping arrangements. They are supplied, as required, to accommodate the types and expected amounts of party line service the office is to furnish.

Ring control distributing blocks, ring control bunching blocks, and blocks for intercepting service are also manufactured in a variety of sizes and strapping arrangements. These are also furnished on the "as required" basis.

Figure 10 illustrates a typical arrangement for terminal blocks on a separate LIDF. This is the means by which the assigned functions for the LIDF in central office operation and maintenance is accomplished. These functions are: (1) the formation of individual and multi-party telephone lines, (2) the distribution and re-distribution of originating and terminating traffic, and (3) the channeling of calls to non-working connector bank numbers to intercepting services.

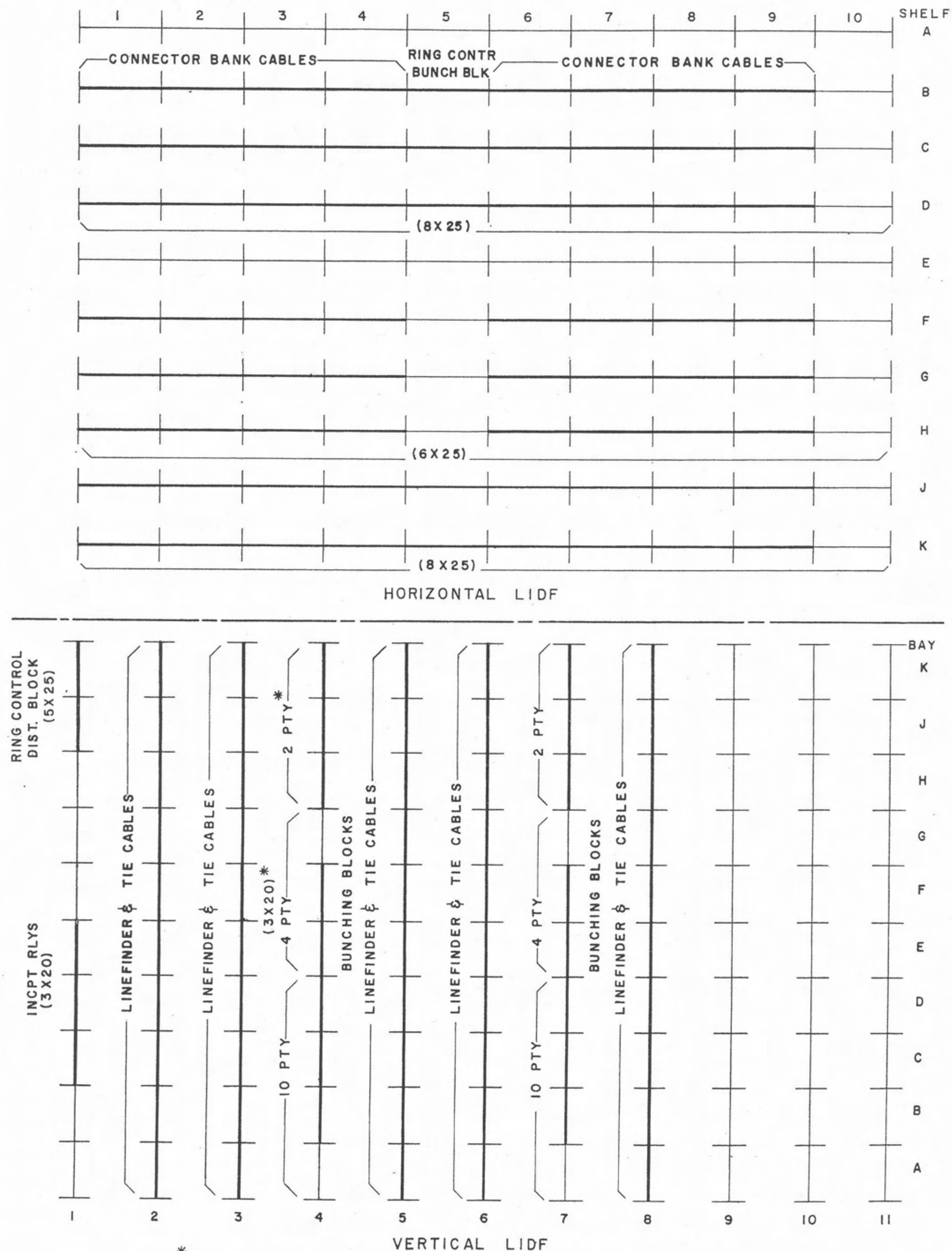
Equipment arrangement on the LIDF to accomplish these functions differ for each of the two types of T/S offices. The application of the LIDF to central office operation, therefore, varies to this extent.

3.3 LIDF terminations. Both T/S office types terminate their line and tie cables on the LIDF in the same manner. A line cable represents 100 3-wire circuits and a tie cable 100 2-wire circuits. When frequency per shelf ringing is used no other cabling is needed except those supplying intercepting service. This is schematically shown in figure 5B. Tie cable circuits (+ and -) are multipled to like leads of the line relay circuits and appear at the MDF as telephone lines of one or more parties identified by their line relay assignment. Connector bank contacts wire to alternate terminals in individual rows of (6 x 20) blocks. Non-working sets of terminals are strapped, lead for lead, to the remaining terminals which, in turn, have been commoned and jumpered to intercepting equipment.

To form an individual party line the assigned line relay and connector bank contacts are jumpered directly. Only a 3-wire jumper is needed to establish a working individual party line at the MDF.

To form a multi-party line requires additional jumpering through strapped terminals of a party line bunching block. The assigned line relay is accommodated on row one of the bunching circuit and connector bank terminals on succeeding rows on the basis of one row per party line station. These are 3-wire jumper runs and their wiring establishes a working multi-party line at the MDF.

Thus line relay circuits and connector bank contacts are associated through jumper runs. These can be easily changed, if necessary, to re-distribute traffic into linefinder boards. The connector bank contacts of T/S exchanges using this 3-wire or frequency per shelf



NOTE:* 2 PARTY BUNCHING BLOCKS MAY BE ELIMINATED BY USING (6X20) BLOCKS

Figure 10. Cable layout for a separate LIDF.

ringing scheme, are terminated as those on shelf K, the HLIDF, figure 10. Note that mounting space bay 5, shelf K is vacant.

The LIDF, of a T/S office using the 4-wire or frequency per terminal ringing scheme, differs from the above mentioned office in the following ways:

1. Requires an additional cable run from the ringing interrupter equipment.

2. Requires a ring control distributing block and several ring control bunching blocks.

3. Uses a 402 conductor instead of a 302 conductor cable to bring 4-wire instead of 3-wire connector bank circuits from the connector shelves to the HLIDF.

4. These 402 conductor cables are terminated on sets of 4 (8 x 25) instead of (6 x 25) terminal blocks.

Line cabling and wiring in addition to jumpering to establish working telephone lines at the MDF follow the procedures of a T/S 3-wire office for the same reasons and with the same results. Intercepting service is also handled in the same manner. The fundamental difference involves the use and the jumpering of that 4th wire of the connector bank circuit. This refers to the fact that a specific ground pulse, when jumpered to this 4th wire of a connector bank circuit, will cause the connector, when this circuit's directory number is dialed, to place a specific ringing code on the associated telephone line to operate the dialed party's ringers. Ringing codes and ground pulses are spaced, on a one for one basis, within the ringing cycle. Thus, the ground pulse assignment for the 4th wire of a connector bank circuit is based on the ringing code needed to signal its associated station. The LIDF arrangement developed to accomplish this ground pulse distribution via single conductor jumper runs is as follows, see figure 10.

Ground pulse leads from the ringing interrupters are terminated on a specially strapped (5 x 25) ring control distributing block mounted on the VLIDF. They are jumpered by connector ringing groups to specially strapped (8 x 25) ring control bunching blocks mounted as the one in bay 5, shelf L, figure 10.

Groups of strapped contacts, each group representing ground pulses for a specific ringing code, and so identified, are now located adjacent to the connector bank contacts with which they are associated. Thus a short jumper from connector bank block to ring control bunching block selects ringing codes for subscriber's station equipment.

The T/S office, especially those using the frequency per terminal ringing plan, offer maximum flexibility in subscriber's dial office equipment distribution. Traffic congestion can be eliminated, directory changes because of station moves are unnecessary, complete line fills are possible, and auxiliary services are minimum. All this adds up to reduced clerical staffs and increased overall operating efficiency.

3.4 Summary. Both T/S central office types require LIDF facilities. These facilities may be incorporated with those of the MDF to form what is known as a CDF. However, larger exchanges often use a separate LIDF erected near the MDF to reduce the length of tie cable runs.

The purpose of this separate LIDF is to prevent cabling and jumpering congestion as is possible with large CDF arrangements.

The functions of the LIDF are:

1. To provide separate and permanent terminations for subscriber's dial office equipment and the tie cables to the MDF.

2. To provide bunching block facilities for the formation of multi-party lines, the distribution of ring control leads, and the grouping of non-working connector bank contacts for intercepting services via non-permanent connections or jumper runs.

3. To promote orderly and systematic distributing frame jumpering.

4. To provide maximum flexibility with reference to the association of LIDF terminated equipment.

5. To promote dial office operating efficiency.

Both T/S central office types use identical LIDF framework. Only block quantities, sizes, and arrangements differ. Each T/S office will have its engineered LIDF terminal block arrangement. Both sides of a properly arranged LIDF will grow at approximately the same rate.

4. TRUNK INTERMEDIATE DISTRIBUTING FRAME

4.1 Design. The framework for the TIDF erected separately is identical to that for the LIDF erected separately. Terminating facilities and cabling standards are alike and blocks mount on both the vertical and horizontal sides.

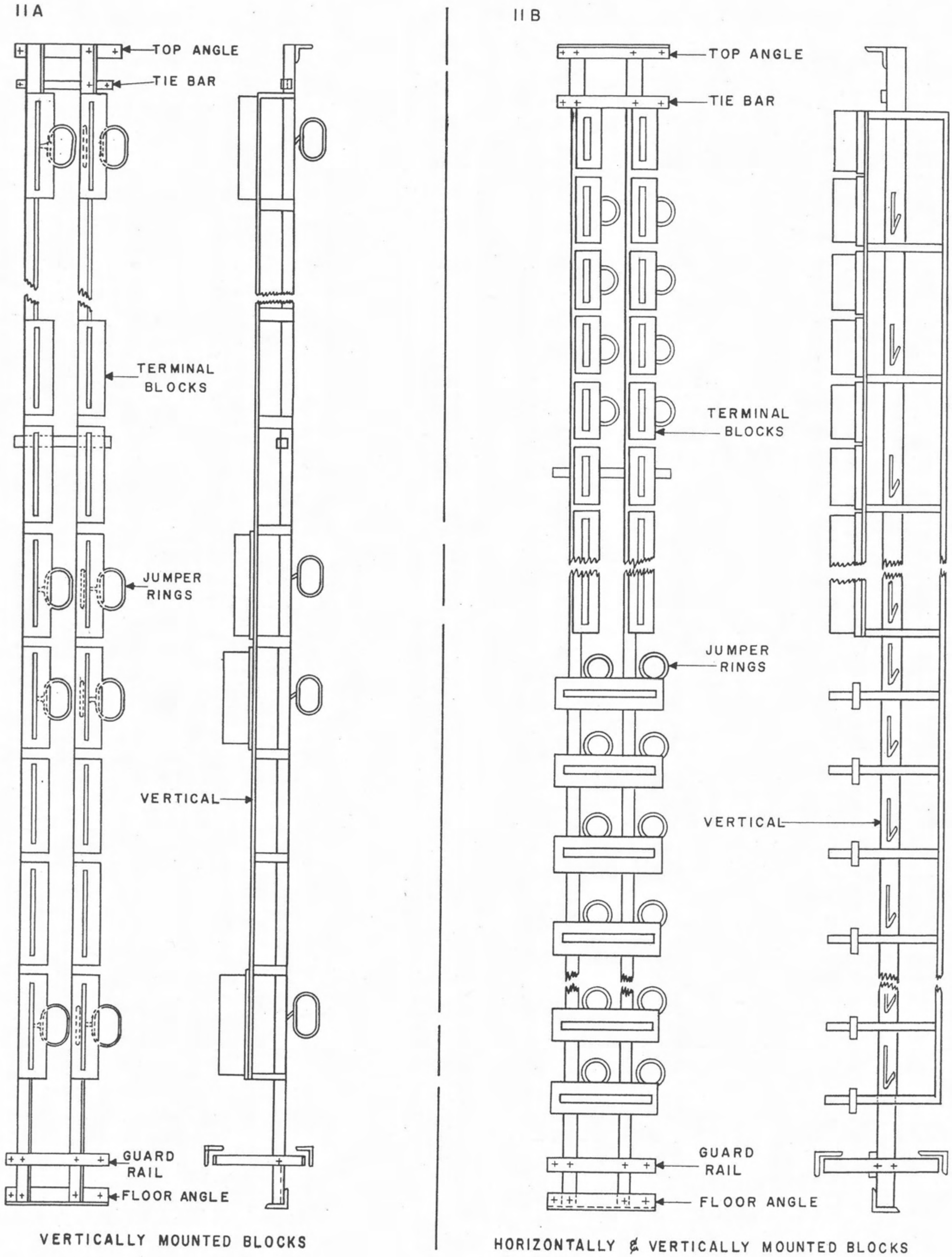


Figure 11. Single-sided TIDF.

TIDF requirements can be also provided for in other ways. They may be incorporated with those of the LIDF or with those of the MDF. It is not unusual to incorporate the TIDF and the LIDF with the MDF facilities to form a CDF arrangement. The TIDF is engineered into the overall floor plan to fit central office operating requirements.

In addition to the double-sided TIDF two types of single-sided TIDF's have been developed, see figure 11. Blocks for one type are vertically mounted, see figure 11A. Blocks on the other mount vertically on the upper portions and horizontally on the lower portions of the framework, see figure 11B. A variety of block sizes may be used with either assembly. They may be erected in a trunkboard lineup to reduce the length of cable runs. Two verticals make one frame unit. Units may be junctioned together forming a frame of any desired length. The single-sided TIDF is exceptionally adaptable since a unit requires but 1'1/2" of floor space. Being the same depth, 1'0", and the same height, 9'0" or 11'8", as trunkboards; the front and rear guard rails form one continuous assembly. When equipment arrangements so dictate this frame may be separately erected.

4.2 Functions. TIDF facilities and hence some form of a TIDF is needed in all dial exchanges. Cabling standards and terminal block sizes and arrangements apply equally to the TIDF erected separately or as part of another distributing frame. The purpose for and the functions of the TIDF, whether single- or double-sided, are the same. A large variety of central office circuitry representing equipment for all manner of dial office services are terminated thereon. Orderly jumpering then forms dial office services out of these isolated dial office components.

The basic purpose for a separate TIDF is to reduce cable and jumper congestion as is possible if large CDF arrangements were used. A primary result from the use of a TIDF is a reduction in the number and length of the cable runs.

The functions of this frame are: (1) to provide a junction point for cables from associated components of equipment located in different areas of the equipment and frame rooms and from toll boards and service desks; and (2) to promote flexibility in the distribution and association of related equipment components through jumper runs.

Since the TIDF is a junction point it may serve as a test point. Maintenance personnel by removing a jumper lead isolates trouble simplifying the search for its exact location. TIDF block stenciling and jumpering tends to clarify the relationship of equipment components to maintenance personnel. He sees, for example, not (1) toll board jacks, (2) relay rack circuits, and (3) operator's selectors; but one OGT to toll train. This, a secondary consideration, nevertheless promotes straight thinking and thus more efficient "trouble shooting".

Figures 12 and 13 illustrate the flexibility and economy resulting from the use of a TIDF. These are real values enhanced by such contributing factors as lower engineering expense, simplified installation, and more orderly straightforward wiring arrangements that promote operating and maintenance efficiency.

4.3 TIDF terminations. The VTIDF provides terminating space for linefinder jacks, rotary switches, trunk circuits, relay rack mounted equipment, etc.; see figure 14.

The HTIDF provides terminating space for selector jacks, test facilities, repeating coils, carrier, toll boards, service desks, etc.; see figure 15.

Linefinder and first selector jacks comprise the largest TIDF group. They are arranged in this manner so that traffic into linefinder shelves may be evenly distributed throughout the first selector shelves and via their banks to the balance of the central office switching equipment. The equal use of all this equipment with no busy hour "overflows" depends on the effectiveness of the linefinder-first selector distribution plan. Therefore, these two components must be jumper connected so that changes, when desirable, may be easily made.

Other central office services, requiring TIDF termination, will usually involve more than two central office components each mounted in different central office areas. The need for TIDF facilities in these instances is even more apparent, see figures 12 and 13, and §4.2. Take as an example the OGT to toll train mentioned in this paragraph. Though only three components are needed to provide this service, each is so different with reference to location, arrangement, circuit capacities, and circuit sizes from the others that their disassociation through the use of individual TIDF termination is unavoidable. Direct connections establish an arrangement that would make changes in or additions to it extremely awkward and expensive. This basic telephone operating problem results in the general practice of the TIDF termination of separate central office components on a permenent basis and then cross-connecting them via easily changed jumper runs. TIDF terminated circuits include all intra- and inter-office trunk cables except those associated with the D.T.A.

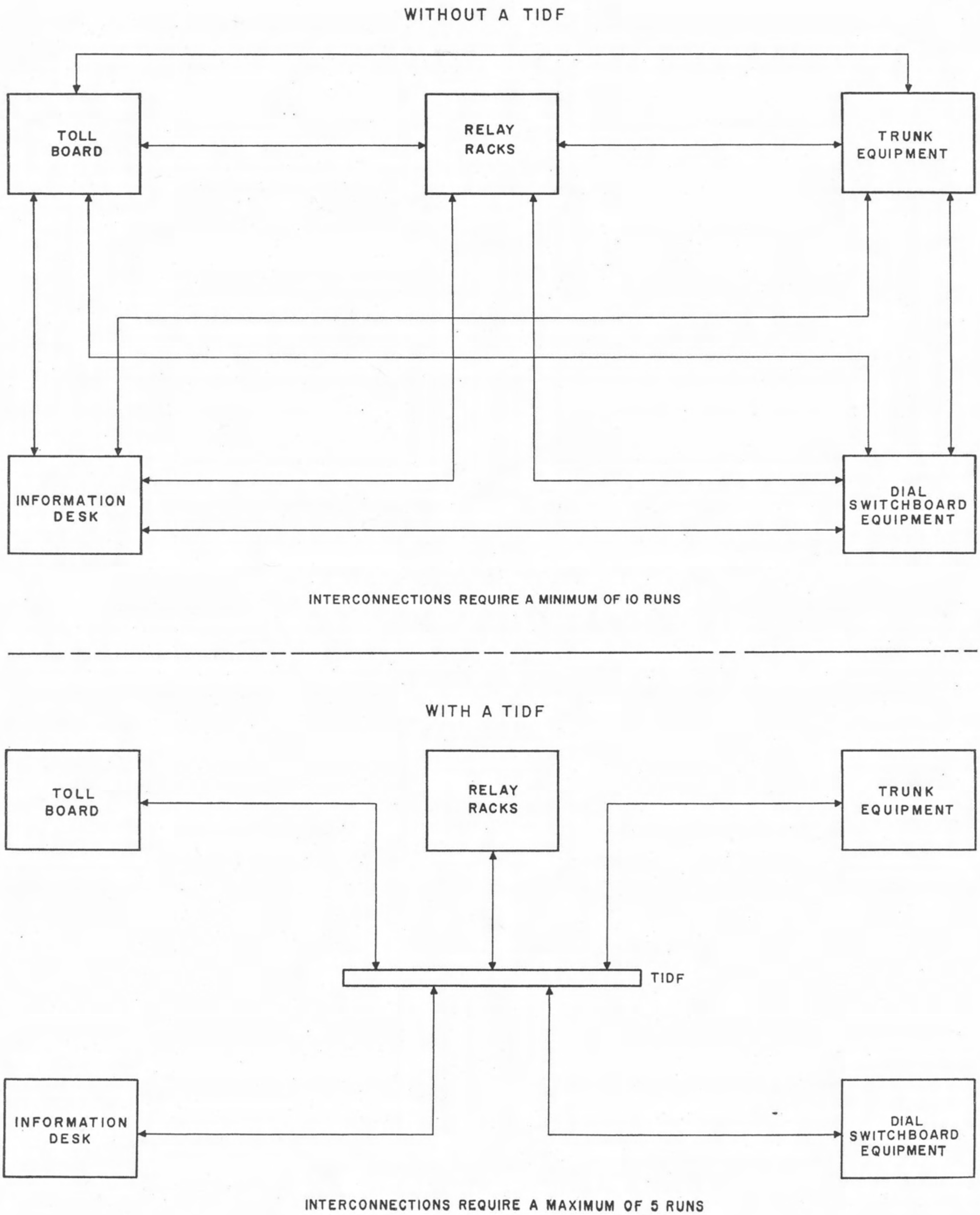


Figure 12. A TIDF reduces the number of cable runs.

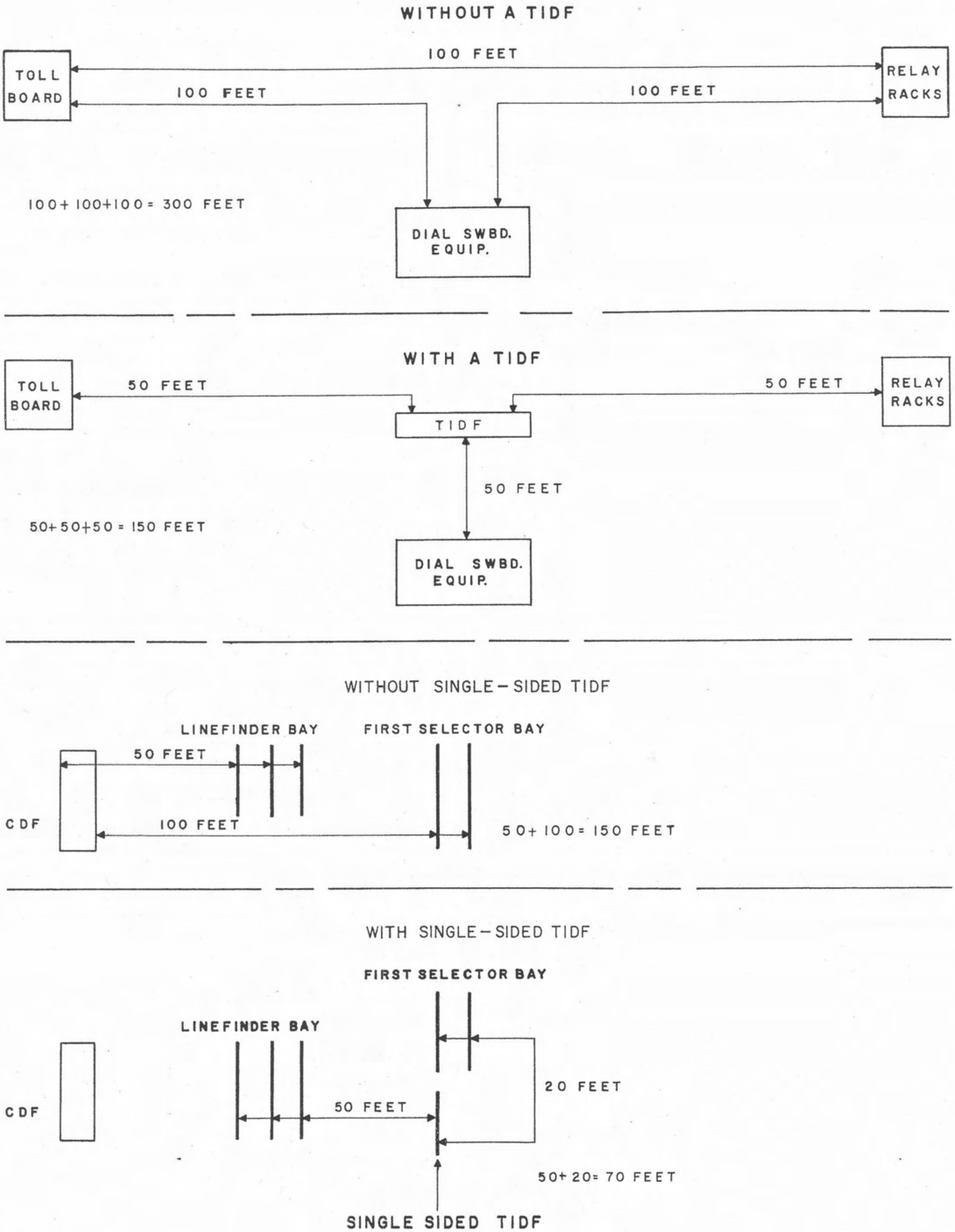


Figure 13. A TIDF reduces the length of cable runs.

VERTICAL TOLL INTERMEDIATE DISTRIBUTING FRAME

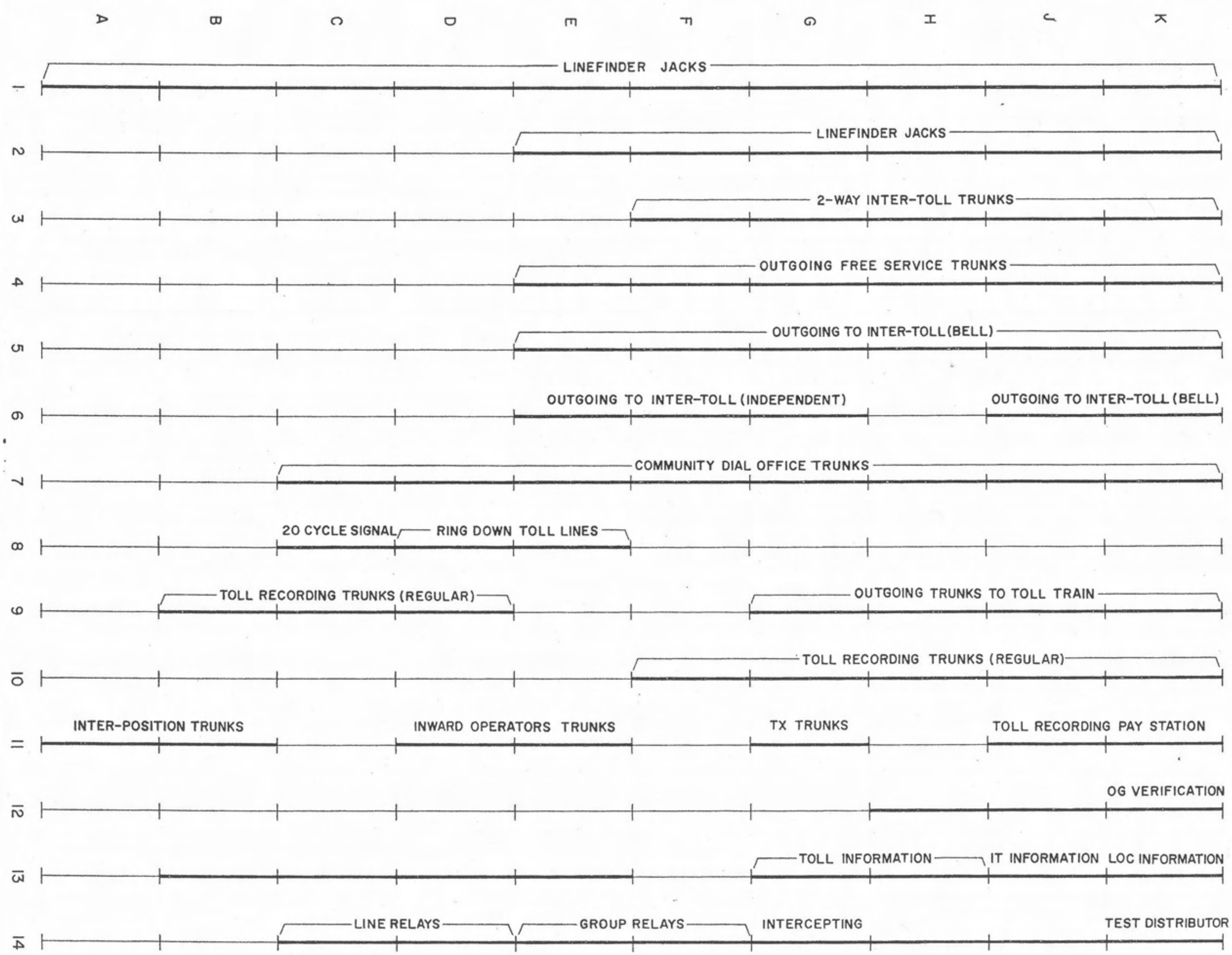


Figure 14. Typical equipment terminations on the vertical TIDF.

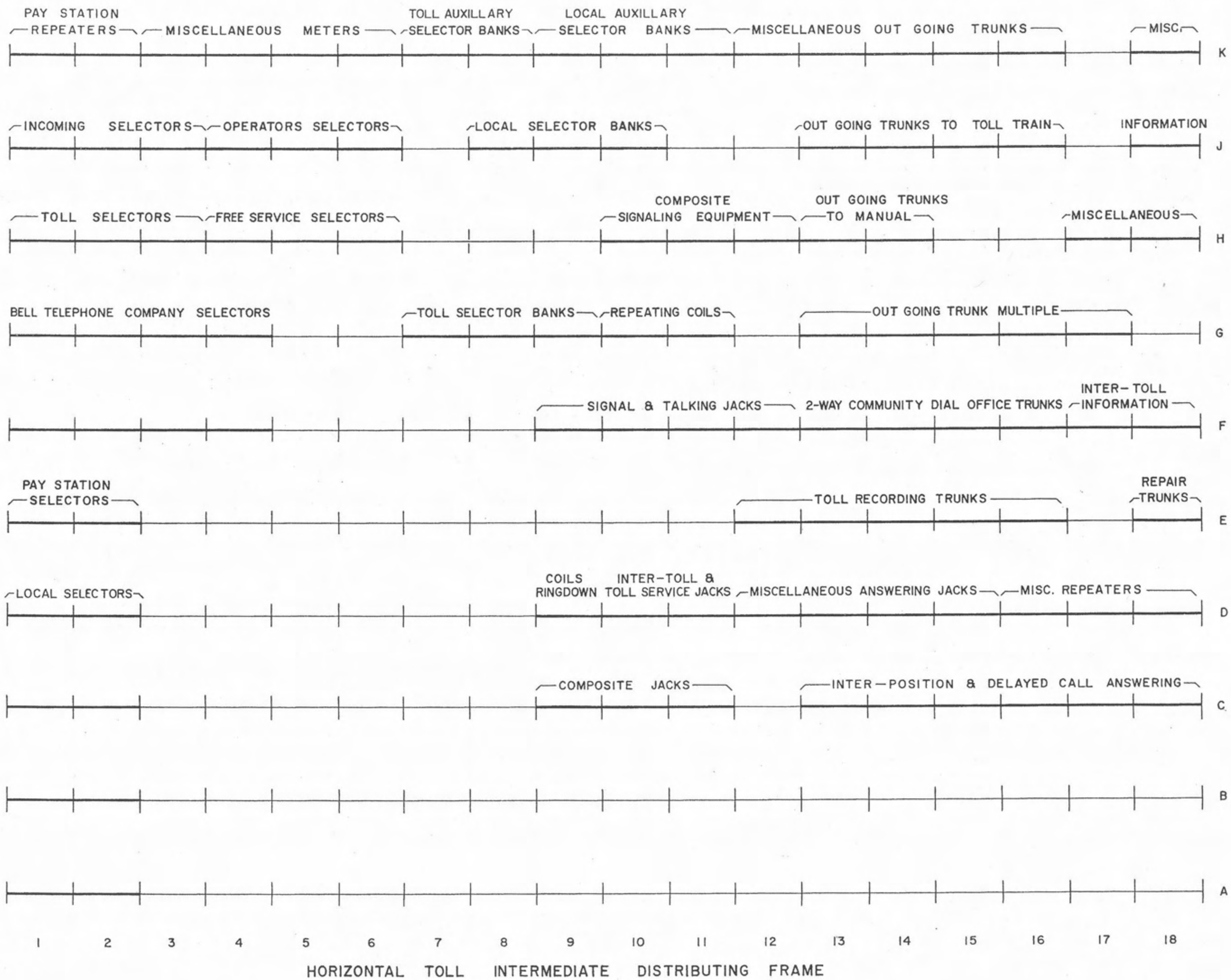


Figure 15. Typical equipment terminations on the horizontal TIDF.

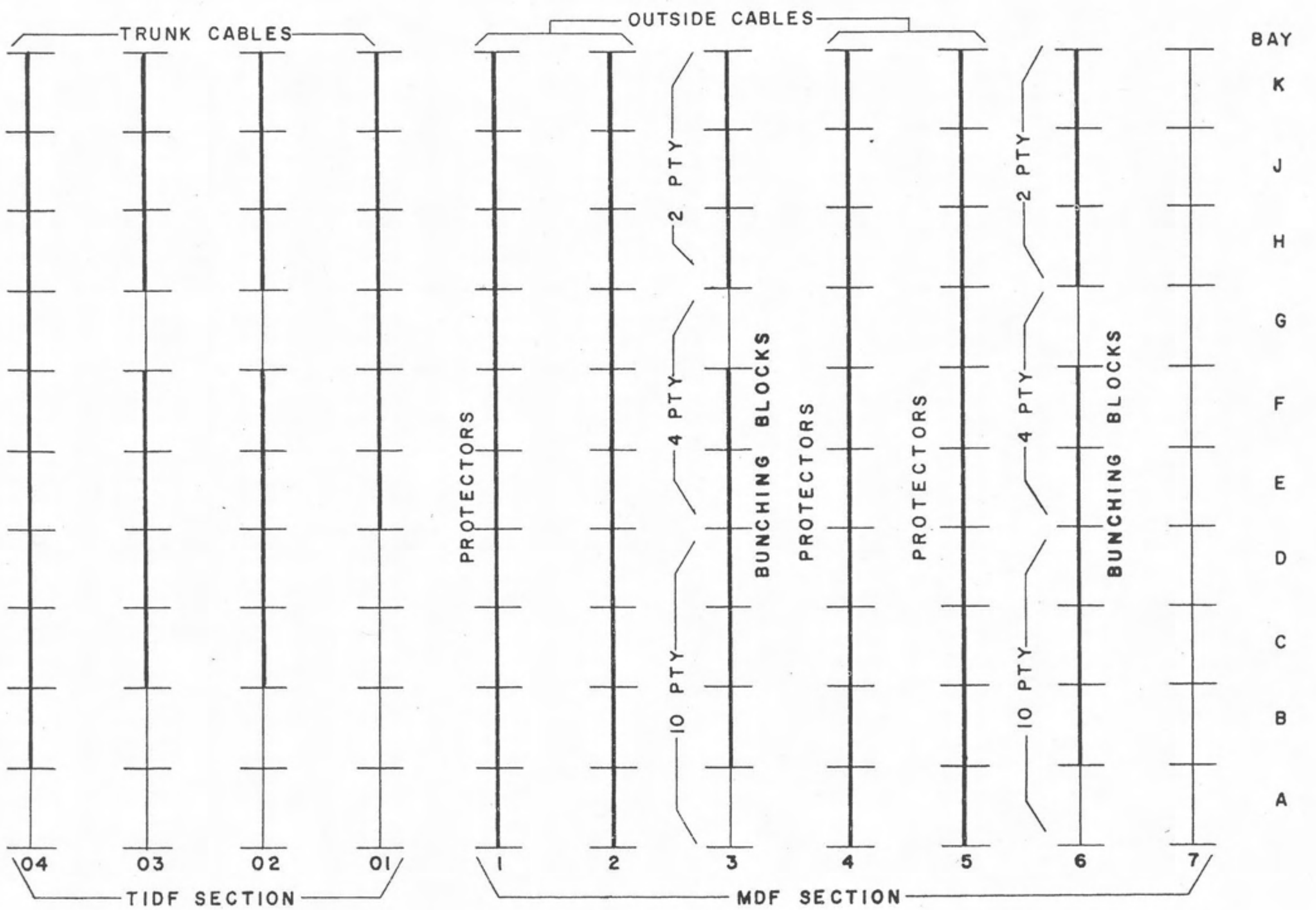


Figure 16. Cable layout for the vertical CDF.

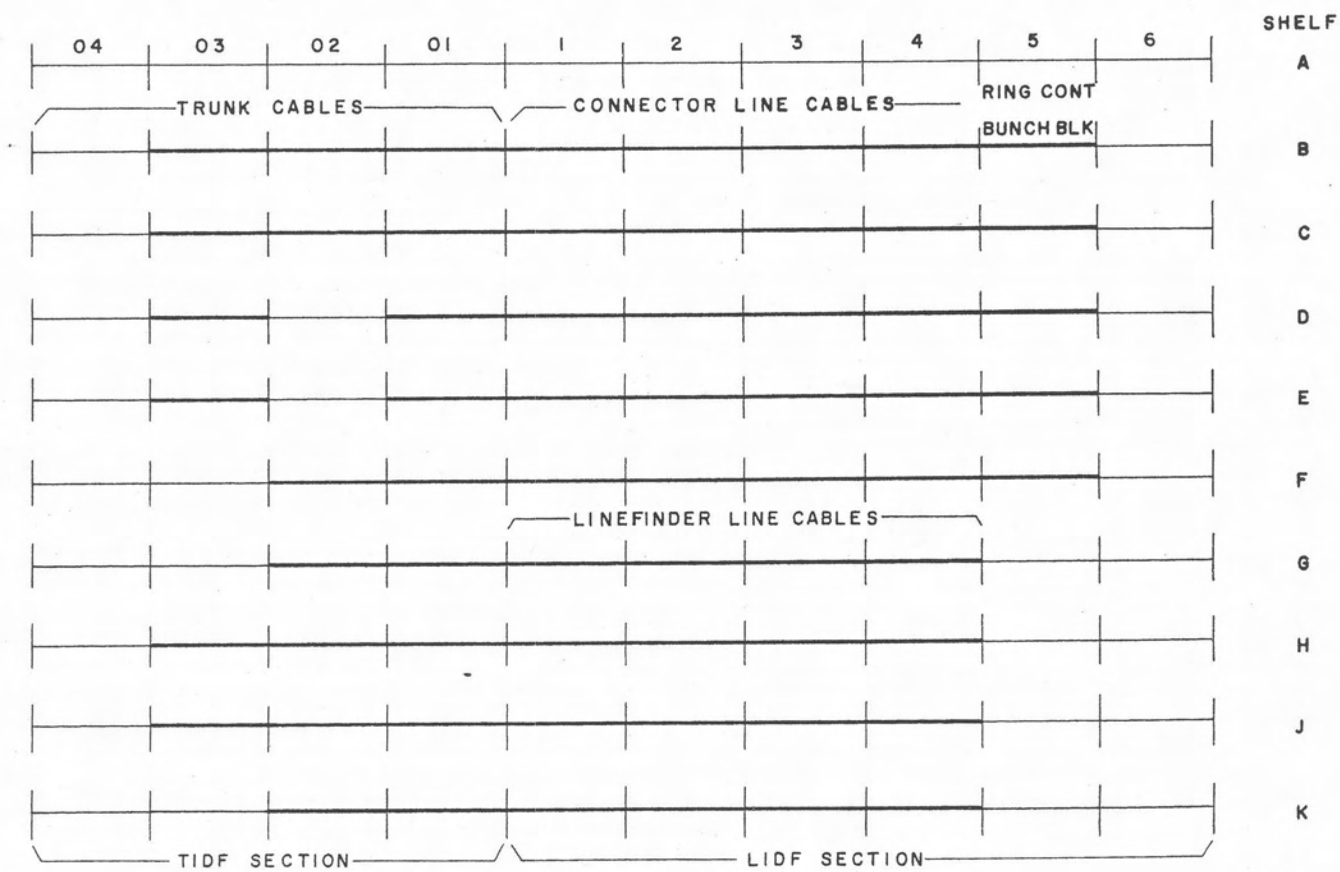


Figure 17. Cable layout for the horizontal CDF.

4.4 Summary. Telephone exchanges need a framework that will provide block mounting space for central office trunk cable terminations. This frame, the TIDF, terminates cables, representing circuits from various central office components, and provides jumpering facilities for cross-connecting them as required to form the many services of a working telephone exchange.

A separate TIDF reduces cabling and jumpering congestion possible if large CDF arrangements were used. Any TIDF arrangement reduces the length of cable runs.

TIDF functions are:

1. To provide a junction point for the components of equipment.

2. To promote flexibility in the distribution and association of these components.

3. To provide a test point between associated components of equipment.

4. Clarifies equipment association to maintenance personnel.

5. COMBINED DISTRIBUTING FRAME

5.1 Design. The CDF, as its name indicates, combines the functions of the MDF, the LIDF, and the TIDF on one continuous framework. It is used in offices not requiring separate distributing frames.

The CDF is actually a MDF with additional IDF verticals. The vertical side mounts protectors and bunching blocks on the MDF section and blocks on the IDF section. Only blocks are mounted on the horizontal side.

The CDF grows from both ends. The MDF section numbers 1, 2, 3, etc., toward its growing end, and the IDF section numbers 01, 02, 03, etc., toward its growing end. Thus verticals 1 and 01 are adjacent verticals, see figures 16 and 17.

Since this frame provides terminations for such a variety of circuitry, its location is of considerable importance. When possible the location should permit cabling convenience for the switching equipment as well as the outside cable plant.

Cable and jumper congestion limits the size of a CDF. An A type CDF is seldem used. The B type is recommended for T/S offices under 2000 lines.

The real advantage accruing from the use of the CDF is the elimination of tie cable runs and the saving in floor space in exchanges where separate frames are not essential.

5.2 Functions. Both line and trunk cables are terminated on the CDF. Line cables for T/L exchanges may be arranged as per figures 4C and 4D and per figures 5A and 6A for T/S offices. The general cable arrangements for both the VCDF and HCDF are shown in figures 16 and 17.

Thus the CDF functions may be said to be those of the MDF, the LIDF, and the TIDF.

Within the limits imposed upon this frame by jumper congestion it is an excellent and economical distributing arrangement. Block sizes are selected so as to prevent the horizontal side from outgrowing the vertical side.

5.3 CDF terminations. The B type CDF is recommended. It provides a better block and cabling arrangement, decreases jumper congestion, and promotes equal growth of the horizontal and vertcial sides of the frame.

Line cables are terminated within the LIDF section of the CDF. Line relay circuits are cabled to the upper portion and the connector bank terminals to the lower portion of this area of the HCDF, see figure 17. In T/S exchanges the latter requires at least twice the area as the line relays and this increases the horizontal needs for the office. The additional vertical mounting space resulting is used for party line bunching blocks, see figure 16.

The outside cable pairs are connected to the protectors mounted in the MDF section of the CDF. This is the typical arrangement; but variations, when desirable, are instituted to fit special local operating requirements.

Trunk cables are terminated on both sides of the TIDF section of the CDF in the usual manner. This section, like the MDF section, grows towards its end of the frame. Normally the expansion of this frame causes no particular problems of cabling or block arrangements.

5.4 Summary. The CDF serves the T/L and the small and medium sized T/S offices very well. Its one limitation is jumper and cable congestion within the frame.

However, it combines the features of the several distributing frames and to this extent meets the varying requirements of dial exchanges and so is considered flexible in application.

It is more adaptable when the engineered floor plan and the building design permit its most advantageous location in the equipment area.

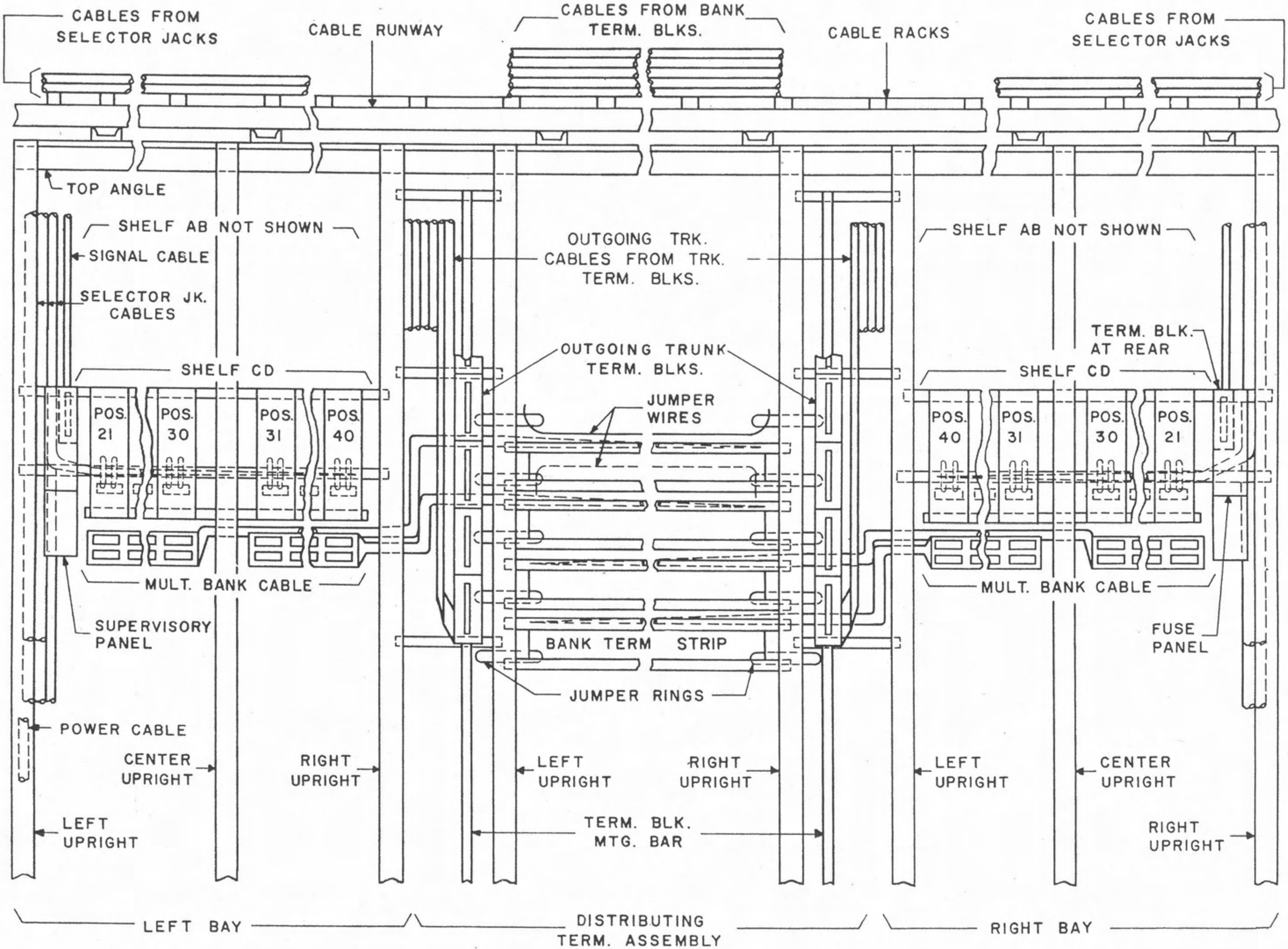


Figure 18. An equipped selector trunkboard and D.T.A.

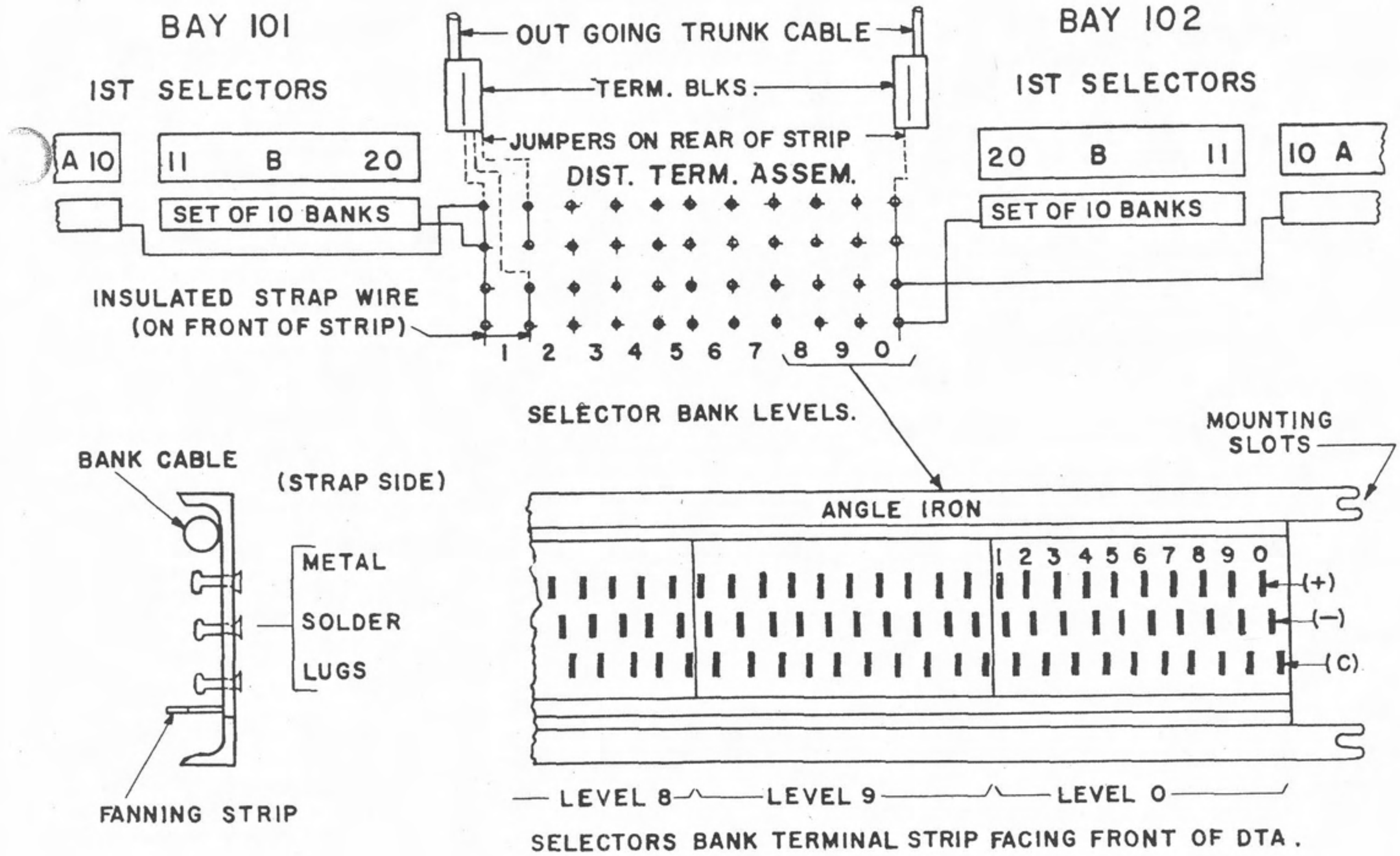


Figure 19. Distribution of trunking from selector trunkboards.

It is not possible to state definitely at what point a dial office is too large for the CDF. Each office is considered individually, its overall requirements for the present and for the future studied, before a distributing frame scheme is determined.

6. DISTRIBUTING TERMINAL ASSEMBLY - D.T.A.

6.1 Design. The D.T.A. is a single-sided distributing frame erected between a left and a right selector trunkboard, see figure 18. Twenty switch selector shelves are hung from the trunkboard uprights. The bank wiring for each grading unit (ten switches in this case) is connected to a bank terminal strip, see figure 19.

Bank terminal strips are mounted in a prescribed order and result in an arrangement where like terminals of all strips are vertically aligned. An additional unwired strip, may be mounted at the top of the assembly to provide terminating facilities for a trunkboard to trunkboard multiple cable.

Each terminal strip contact represents a terminating point for a selector bank contact which has been multipled across ten selector banks. The standard terminal strip has 300 such contacts representing 100 3-wire circuits on the basis of ten circuits per level for ten selector bank levels, see figure 19. Note: special banks of 400 terminals representing 100 4-wire circuits are also manufactured for toll or other special services.

The D.T.A., in a limited space, arranges selector bank circuits by levels for easy vertical strapping together or for jumpering to an outgoing trunk to the next rank of equipment. Outgoing trunk cables are connected to blocks arranged on either side of the D.T.A. This separation of bank circuits and trunk circuits permits traffic distribution between equipment.

6.2 Functions. The D.T.A. serves as a distributing point for circuits and thus traffic from one rank of switches to the next. Being a distributing point it is also a test point for maintenance personnel. Testing, in this instance, is aided by detailed block stenciling, the selector bank cards, and the terminal assembly print all considered part of the D.T.A.

The D.T.A. provides terminal block mounting space for trunk cables and terminal strip mounting space for selector bank contacts.

Selector bank contacts, having the same outgoing trunk, are strapped on the front of the assembly. A jumper from the rear of the assembly to a specified terminal block circuit connects the selector level choices to an outgoing trunk to the next rank of equipment.

Thus the D.T.A. provides a flexible method for distributing circuits and therefore traffic from one rank of switches to another. To this extent the function of the D.T.A. is also the promotion of exchange operating efficiency.

Lastly, changes in or additons to trunking plans can be easily and inexpensively made without disturbing service. Only strap and jumper wire is required and a simple procedure allows the installer to deny a working circuit to subscribers while working on it.

6.3 D.T.A. terminations. The following circuitry is terminated on a D.T.A.:

1. Trunks to the next rank of Strowger switches; i.e., 2nd selectors, 3rd selectors, connectors, etc.

2. Outgoing trunks to other offices.

3. Special service trunks to desks.

4. CLR trunks to toll board.

5. "Dead level" intercepting trunks.

Trunks accessed from levels 1 through 5 are wired to blocks mounted on the left side of the D.T.A. Trunks accessed from levels 6 through 0 are wired to blocks mounted on the right side of the assembly. This plan divides the jumpering at the center of the assembly promoting neat appearing runs without congestion. Trunk cables are wired to the outside and the jumpers to the inside of the terminal blocks to further promote orderly jumpering.

Other bulletins cover the details regarding distribution of these trunk circuits, selector bank multipling plans, "grading" selector levels, etc. It is not intended that bulletin 803 duplicate this information. Bulletin 803 is only concerned with the design of the facilities needed by the D.T.A. to perform its functions properly.

A selector is one of a group of switches that permit subscribers to select one of a group of trunk circuits, as required, to advance the call another step towards its destination. The selector when making this selection must avoid the busy ones. No selector is assigned trunk circuits for its individual use.

Thus D.T.A. terminated trunk circuits must be jumpered not to one but to several selector bank contacts. The D.T.A. bank terminal strip mounting arrangement accomplishes this in a simple orderly fashion.

For example: assume that the first set of bank contacts, level "0" for 6 shelves or 12 grading units is assigned CLR trunk #1. This set of bank contacts of the strip mounted uppermost in this group is jumpered from the rear of the strip to terminal block lugs wired with CLR trunk #1. Vertically strapping this set of bank contacts to like sets of contacts of the following eleven terminal strips on the front of the assembly makes CLR trunk #1 available to 12 grading units or 120 switches. The first switch selecting CLR trunk #1 will be permitted to use it. A second attempt is prevented by selector design from choosing CLR trunk #1 because of a changed circuit condition passed to selector #2 via this strapping. Selector #2 is automatically assigned to the first idle trunk.

Hence the D.T.A. not only terminates trunk circuits, distributes trunk circuits, and connects trunk circuits to bank contacts by a flexible method; but it also provides an arrangement whereby incoming traffic is prevented from accessing busy ones, yet assigned the first idle one.

Trunk circuit usage is changing all the time. Busy circuits become idle and vice versa. This constant change is immediately transferred to all accessing switches. Thus traffic going forward may be rapidly routed with no delays or interference towards call completion.

6.4 Summary. When switch ranks are of sufficient size, some orderly, simple, and flexible method for distributing traffic between them is required.

As traffic patterns change or when equipment additions are installed, the established distribution scheme must be easily and economically changed without disturbing the subscribers.

Proper traffic balance throughout the exchange is the basis for operating efficiency. The selector D.T.A. was designed to meet these requirements.

Revised April 1959

Printed in U.S.A. by Brookes & Sons Company 1000 4-59

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